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(54) CAST WHEELS

(71) We, COURTAULDS LIMITED, a British Company, of 18, Hanover Square, London, W.1, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the production of cast filled synthetic resin wheels for use for the application of lubricant compositions to textile filaments or threads.

Lubricant application wheels used for this purpose are required to have a peripheral surface which is readily and evenly wetted by the lubricant solution, which is resistant to wear by the textile filaments which are in contact with it, and which may in some cases require to be divided into a number of independent component peripheral surfaces by circumferential grooves. The wheels may be composed of various different materials, but a particularly useful type of wheel can be made by centrifugal casting of a liquid hardenable resin which contains a proportion of a filler which concentrates towards the peripheral surface during the centrifugal casting process. It is an object of this invention to provide a process for the production of textile yarn lubricant application wheels and like devices, having smooth, matt, readily-wetted, abrasion resistant surfaces divided, if desired, into component peripheral sections by means of circumferential grooves.

According to the invention, a process for the production of a cast wheel comprises subjecting a liquid hardenable resin, which contains a particulate filler, to centrifugal casting in a mould of the desired hollow cylindrical shape, and theating the surface of the formed wheel with a solvent for the resin in its hardened form, to provide a smooth matt finish thereon.

A wheel with a continuous surface according to the invention may, for example, be cast in a polished, cylindrical metal cavity, capable of being rotated after addition of the charge, and dismantlable so that the cast wheel may be removed. In such a process, a charge of a liquid, hardenable resin, such as an epoxy resin precursor, containing a particulate filler, is cast in the cavity, which is rotated rapidly around its cylindrical axis while the liquid is hardening. If desired, more than one charge may be used in which case the preceding charge is allowed to cure at least partially, so as to be at least semi-solid, before the further liquid charge is added. Charges other than the first may or may not contain fillers and they may be cast onto the first charge either centrifugally or statically using the cured or partially cured first charge as part of the casting cavity. The same type of resin may be used for all of the charges or different resins may, if desired, be used providing that the contacting resins of different types adhere to one another. It will usually be necessary to employ a mould release agent in the cavity, to ensure easy removal of the casting. If peripheral grooves are required in the surface of the wheel, to divide that surface into two or more peripheral sections, they may be cut into the wheel with a suitable thin tool, such as a diamond wheel.

In another form of the invention, grooves may be cast in the wheel initially.

According to this form of the invention, a mould of the type described having two side plates and a ring of suitable diameter, which ring is provided with two or more peripheral internal flanges suitably positioned to give the grooves desired in the surface, has the ring section divided into two or more parts. The mould may be lined in the cavities between the flanges before casting the wheel by centrifugally casting therein quantity of a liquid hardenable synthetic resin which is insufficient to fill the spaces between the peripheral internal flanges. In this way a smooth surface through which the tops of the

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flanges protrude may be presented. The mould thus lined may be coated with a suitable mould release layer and the main casting process may then be carried out using a liquid hardenable resin containing a particulate filler. On completion of the casting process the mould sections may be dismantled, and the thin resin lining rings broken off to release the cast article. In this form of the invention the mould may be of any suitable material such as metal or synthetic material, and may, if desired, be made up from thin flat rings of a plastics material such as polypropylene (to give the grooves) spaced apart by somewhat greater internal diameter wider metal rings (to give the plateaux).

In still a further form of the invention, a mould may be lined with a cylinder of an elastomeric material or a strip of elastomeric material curved to form a cylinder. The cylinder or curved strip is fitted onto the inner wall of the rigid ring as a liner and has circumferential flanges on its inner face. Such a mould lining may be produced, for example, by centrifugally casting the elastomer in a cylindrical mould having circumferential grooves on the inner face of the casting chamber to produce an elastomeric ring with flanges on its outside. The elastomeric ring may then be turned inside out and used to line a plain ring to form the mould. After casting and dismantling, the elastomeric ring liner may be removed with the casting from the metal ring and then the elastomeric rin liner removed from the casting by stretching. In the same way as before, suitable release agents may be used between the elastomeric ring and the casting and between the elastomeric ring and the outer plain ring. If desired the ring mould which is lined by the elastomeric ring may be that ring mould used to produce the elastomeric ring in the first place.

An alternative method of producing an elastomeric mould lining, consists in preparing a model of the grooved wheel which it is desired to produce, placing it centrally inside a rigid ring of larger diameter and filling the unoccupied space with a castable elastomer composition. After removal of the model and casting from the ring the elastomer material is separated from the model, reinserted in the ring and used to produce a centrifugally cast wheel as before.

After casting the wheel, whether the surface be grooved or smooth, the surface layer of the resin in its hardened form is treated with a solvent, preferably a degradative solvent. for that resin, in order to remove a minutely thin surface layer of resin and provide a smooth matt finish on that surface consisting principally of particles of the filler used. Thus, for example, an epoxy resin wheel, containing a filler such as silicon carbide, may be treated with concentrated sulphuric acid, which degrades the surface layer leaving the desired matt surface.

The liquid hardenable resin used in the process of the invention may be of any suitable kind, such as, for example, a polyester resin or a partially formed phenol formaldehyde resin, but for many purposes an epoxy resin composition is preferred. Tough resilient resins may also be employed such as those formed from the reaction of certain diamines (e.g. "NOCA" (Trade Mark) du Pont), with isocyanate-tipped linear low polymers (e.g. "Adiprene" (Trade Mark) L100, du Pont). As a filler material substantially any substance conferring the required anti-wear properties may be used provided that its density is such as to cause it to concentrate on the peripheral surface of the cast during the centrifugal casting process. Preferred materials include precipitated silica, sand, silicon carbide, alumina, titanium dioxide and powdered slate. The particulate filler materials are preferably finely divided and of uniform particle size, although mixtures of finer and coarser particles may be advantageous in some cases from the point of view of high packing density. The character of the matt surface resulting from the treatment of the curved surface with a degradative solvent for the resin may be modified by varying the particle size of the particulate filler.

Lining materials include similar liquid hardenable resins to those used in the construction of the wheel where the mould is of the kind which can be separated into sections, or silicone rubber and plasticised polyvinyl chloride casting compositions where the rubbery mould is to be removed from the cast by stretching.

The wheels made by any of the above processes are made suitable for mounting on a shaft by machining in them central holes of suitable size.

EXAMPLE 1

A centrifugal casting chamber, consists essentially of a metal ring of internal diameter 4.75 inches and length 1.75 inches with a smooth, polished inner surface, to which can be bolted two end plates each consisting of inner, shaped polypropylene portions strengthened by outer, flat metal portions. The lower end plate is axially fixed in a horizontal position on a vertical shaft which is capable of being rotated at 1000 r.p.m. The upper plate has a hollow, internally-conical extension with a removable cover, through which liquid resin may be charged to the chamber. The as-

sembly may be readily dismantled and reassembled and is normally fixed together by means of bolts passing through the three main components.

The interior parts of the casting chamber are sprayed with a fluorinated hydrocarbon aerosol preparation, assembled, a liquid resin charge consisting of,

"Epikote" 828	150 gm
"Epikure" RTH	80 gm
"Epikure" RTA	4 gm
"Aloxite" 225	100 gm

("Epikote", "Epikure" and "Aloxite" are Trade Marks)

introduced and the assembly rotated to throw the liquid charge onto the outer circumferential wall to form a layer about 1.5 cm thick. Rotation is continued for 6 hours.

"Epikote" 828, "Epikure" RTH and "Epikure" RTA are epoxy resin components marketed by the Shell Chemical Co. Ltd. "Aloxite" 225 is a finely-divided aluminium oxide grinding powder marketed by the Carborundum Co. Ltd.

During the early part of the 6 hours period, while the resin remains liquid, the dispersed aluminium oxide particles move outwards through the resin to form a component outer layer containing a high proportion of aluminium oxide. After the 6 hours the resin has set solid and rotation is stopped.

A liquid resin composition consisting of

"Epikote" 828	100 parts by weight
"Epikure" RTH	55 parts by weight
"Epikure" RTA	1 part by weight

is now poured in until its level rises into the conical filling hole and rotation is again started. 16 hours later, when the second resin charge has set solid, rotation is stopped and the top end plate removed. The ring and its solidified contents are then also removed from the lower plate and placed in an oven at 60°C for 24 hours to complete the cure of the resin charges. The ring and its contents are then allowed to cool and the casting pushed out of the ring. At this stage, the casting comprises of an outer ring consisting of a high proportion of aluminium oxide embedded in solid resin, supported by an interior portion of pure resin having profiled faces corresponding with the shape of the polypropylene and plates of the casting chamber. There is a central axial hole of paraboloidal shape, the size of which depends upon the exact quantity of the second resin charged used. The outer, curved surface of the casting is smooth, corresponding with the smoothness of the inner surface of the metal ring.

The casting is mounted in a lathe and the centre axially machined out to the size dimensions of the spindle on which it is to be mounted in service. It is then mounted on a short shaft and, with the shaft horizontal, slowly rotated while the curved surface dips into a bath of concentrated sulphuric acid at room temperature. After one minute's treatment, the surface is washed with water to remove excess acid and the products of decomposition of the resin, allowed to stand in cold water for one hour and then dried. The outer surface is now of a smooth, matt appearance and is readily and evenly wetted by aqueous solutions and dispersions.

Wheels so produced may be used directly for the application of finish to textile threads in the well-known manner. Alternatively, they may be modified before use by cutting circumferential grooves in them, for example, by means of a thin, diamond-tipped grinding wheel, so as to divide their surfaces into circumferential plateaux, one for each thread.

EXAMPLE 2

In a procedure otherwise identical with that of Example 1 the first liquid resin charge given therein is substituted by

"Adiprene" L100	200 gm
Slate powder 250 mesh	100 gm
"NOCA"	22 gm

"Adiprene" L100 is an isocyanate-tipped linear polymer and "NOCA" is a diamine curing agent therefor. Both are proprietary products marketed by the Du Pont Co.

The charge is prepared by dispersing the slate powder in the warmed "Adiprene" using a mechanical mixer and then continuing the mixing while the molten "NOCA" is slowly poured in.

The outer surface of the lubricant application wheel thus produced is somewhat resilient and more resistant to damage when accidentally knocked than wheels produced by the method of Example 1.

EXAMPLE 3

In a centrifugal casting device similar to that described in Example 1, the metal ring consists of two semicircular segments each of which has five internal semicircular flanges. When the segments are placed together to form a complete ring, the flanges correspond to form continuous circular flanges. The segments are so designed that they may be fixed together by means of bolts.

The interior parts of the casting chamber components are sprayed with a fluorinated hydrocarbon mould release agent and the metal ring and end plates are assembled, the axis of rotation in this case being horizontal.

A quantity of a liquid epoxy resin composition consisting of

"Epikote" 828 100 parts by weight
"Epikure" RTH 55 parts by weight
"Epikure" RTA 10 parts by weight

is introduced, the quantity being such that when the casting chamber is in rapid rotational motion, the troughs between the flanges of the ring will be only partially filled with resin: the flanges will project above the liquid resin surface by $\frac{1}{16}$ inch. When the equipment is stationary, however, as during charging, this quantity forms a liquid pool, the level of which lies above that of the lowest point of the flanges and the charge distributes itself evenly in the axial (horizontal) direction.

The casting chamber is rotated about the horizontal axis for 16 hours during which time the resin sets solid. In this way each trough is uniformly coated with layer of solid resin having an unbroken, circular, inner surface.

The end plate carrying the filler extension is removed, the free resin surface is sprayed with the mould release agent, the end plate replaced, and the assembly positioned so that it may now rotate with its axis vertical. Two liquid resin charges similar to those of Example 1 are successively introduced, allowing 6 hours for the first to solidify and 16 hours for the second.

The segmented ring and its contents are detached from the end plates and heated in an oven at 60°C for 24 hours. The bolts are then removed and the segments separately removed from the composite resin casting by pulling them in the radial direction at right angles to their division plane. The casting thus obtained consists of a grooved wheel blank having rings around the raised portions.

The rings are removed to expose the working surface of the completed wheel blank. This is circular in shape to a high degree of accuracy and has no discontinuities in the outer surface such as would have arisen as a result of the join in the segmented ring if the first resin charge, partially filling the troughs, had been omitted during the casting procedure.

The wheel is completed for use by turning out the central portion to the shape required for mounting on the machine, and treating the outer surface with sulphuric acid, as described in Example 1, to obtain a smooth, matt surface.

EXAMPLE 4

In a centrifugal casting device similar to that described in Example 1, the metal ring has five circular grooves machined into its inner surface.

The equipment is assembled and rotated with the axis horizontal while a quantity of silicone rubber casting composition, sufficient to give a layer $\frac{1}{8}$ inch thick on the curved surface of the ring, is centrifugally cast therein.

The equipment is dismantled, the rubbery cast removed from the ring, turned inside out and reinserted in the ring.

The equipment is reassembled, the inner parts treated with a fluorinated hydrocarbon mould release agent, and two resin charges similar to those of Example 1 are successively cast therein with the axis of rotation vertical.

The equipment is again dismantled, the contents of the ring pushed out and the silicone rubber outer layer removed to expose a finished application wheel blank, ready for machining, having five circumferential grooves.

The outer surface is treated with cold concentrated nitric acid for 5 minutes to form a matt, smooth, easily-wetted surface.

WHAT WE CLAIM IS:—

1. A process for the production of a cast wheel which comprises subjecting a liquid hardenable resin, which contains a particulate filler, to centrifugal casting in a mould of the desired hollow cylindrical shape and treating the surface of the formed wheel with a solvent for the resin in its hardened form, to provide a smooth matt finish thereon.

2. The process claimed in Claim 1 in which the liquid hardenable resin is cast in a polished cylindrical metal vessel capable of being rotated after introduction of a charge of the resin and filler and dismantlable so that the cast wheel may be removed.

3. The process claimed in Clam 1 or Claim 2 in which the wheel is cast by feeding at least two charges of resin to the mould, of which charges at least the first contains a particulate filler.

4. The process claimed in Claim 3 in which the different charges are all of the same liquid hardenable resin with or without filler.

5. The process claimed in any preceding claim in which the cavity in the mould is treated with a mould release agent before the addition of the charge.

6. The process claimed in any preceding claim in which peripheral grooves are cut into the wheel after casting to divide the peripheral surface of the wheel into separate sections.

7. The process claimed in Claim 1 in which peripheral grooves are cast into the wheel during its production.

8. The process claimed in Claim 7 in which the mould has two or more internal flanges positioned to provide the peri-

pheral grooves and the mould vessel is divided into at least two sections.

9. The process claimed in Claim 8 in which the mould vessel is lined before casting the wheel by casting therein a quantity of a liquid hardenable resin which is insufficient to fill the spaces between the peripheral internal flanges.

10. The process claimed in Claim 9 in which the lining is treated with a mould release agent before casting the wheel therein.

11. The process claimed in Claim 9 in which the wheel is removed from the mould by dismantling the mould vessel and breaking off the resin lining rings.

12. The process claimed in Claim 1 in which a smooth cylindrical mould is provided with a lining of elastomeric material having internally directed peripheral flanges.

13. The process claimed in Claim 12 in which the elastomeric liner is produced by casting an elastomeric material in a cylindrical mould having circumferential grooves in the inner face thereof, the cast elastomeric ring being turned inside out before it is used as a liner for a casting mould.

14. The process claimed in Claim 12 in which the elastomeric ring is treated on the inner surface thereof with a mould release agent before casting the wheel therein.

15. The process claimed in Claim 12 in which the elastomeric ring is cast around a fabricated model of the desired wheel, separated from the model and inserted within the mould vessel.

16. The process claimed in any preceding claim in which the surface layer of the resin wheel after hardening is treated with a degradative solvent for that resin.

17. The process claimed in Claim 16 in which the liquid hardenable resin is an epoxy resin and the degradative solvent is concentrated sulphuric acid.

18. The process claimed in any preceding claim in which the liquid hardenable resin is a polyester or a partially formed phenol formaldehyde resin.

19. The process claimed in any preceding claim in which the particulate filler is precipitated silica, sand, silicon carbide, alumina, titanium dioxide or powdered slate.

20. The process for the production of cast wheels as described in the Examples herein.

21. Cast wheels whenever produced by the process of any of the preceding claims.

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